DETAILED ACTION

Continued Examination Under 37 CFR 1.114

A request for continued examination under 37 CFR 1.114, including the fee set forth in 37 CFR 1.17(e), was filed in this application after final rejection. Since this application is eligible for continued examination under 37 CFR 1.114, and the fee set forth in 37 CFR 1.17(e) has been timely paid, the finality of the previous Office action has been withdrawn pursuant to 37 CFR 1.114. Applicant's submission filed on 3/31/08 has been entered.

Response to Arguments

Applicant's arguments with respect to claims 1-20 have been considered but are moot in view of the new ground(s) of rejection as explained hereunder.

Applicant has amended claims 1, 5-7, 9-11, 15, 18 and 19 by adding new limitation (for example in claim 1 new limitation "the antenna being disposed on the top plate member and being in close contact therewith" has been added besides other limitations. Further, applicant has cancelled claims 8, 13-14, 17 and 20-22.

Accordingly claims 1, 5-7, 9-11, 15 and 18, 19 are presently pending and active.

New reference by Watanabe et al (JP 11-260594) when combined with Chen et al reads on amended claim 1 limitations including the newly added limitation "the antenna being disposed on the top plate member and being in close contact therewith". Accordingly claims 1, 5-7 and 10 have been rejected under 35 USC 103 (a) as explained below. Further, Watanabe et al in view of Chen et al when combined with Ishii et al reads on amended claim 11 limitations. Accordingly claims 11, 15, 18 and 19 have also been rejected under 35 USC 103 (a) as explained below. Balance claim 9 has also been rejected under 35 USC 103 (a) as explained below.

Regarding applicant's arguments that Chen does not teach an antenna having plurality of slots, examiner responds that newly cited reference by Watanabe et al teach an antenna with plurality of slots and disposed above and in contact with dielectric top plate unit. Further, regarding applicant's arguments that Ishii et al does not teach an antenna in close contact with the dielectric plate, examiner responds that newly cited reference by Watanabe et al teach an antenna with plurality of slots and disposed above and in contact with dielectric top plate unit and that Ishii et al is cited for its teaching pertaining to gap between the slot antenna and the dielectric plate.

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

This application currently names joint inventors. In considering patentability of the claims under 35 U.S.C. 103(a), the examiner presumes that the subject matter of the various claims was commonly owned at the time any inventions covered therein were made absent any evidence to the contrary. Applicant is advised of the obligation under 37 CFR 1.56 to point out the inventor and invention dates of each claim that was not commonly owned at the time a later

invention was made in order for the examiner to consider the applicability of 35 U.S.C. 103(c) and potential 35 U.S.C. 102(e), (f) or (g) prior art under 35 U.S.C. 103(a).

Claims 1, 5-7 and 10 are rejected under 35 U.S.C. 103(a) as being unpatentable over Watanabe et al (JP 11-260594) in view of Chen et al (US Patent No. 5,234,526).

Regarding Claim 1: Watanabe et al teach a plasma apparatus comprising:

a chamber 1 for accommodating a substrate 10;

a dielectric top plate member 2 with a flat plate shape disposed in an upper portion of the chamber;

an antenna 6 having a plurality of slots 8 for irradiating a microwave towards an inside of the chamber1 (e.g. Figs. 1-3 and para. 0008-0012);

Watanabe et al do not teach a gas injection opening for supplying a processing gas into the chamber; and

a vacuum pump for exhausting the inside of the chamber,

wherein the top plate member includes:

a dielectric flat plate portion formed to face the substrate; and

a dielectric sidewall portion formed to extend from a peripheral region of the flat plate portion towards the substrate, and

wherein sides of the flat portion and the sidewall portion facing a plasma generation region have a curved surface extending between the flat plate portion and the sidewall portion and the sidewall portion has a thickness not smaller than lambda/4 but not greater than lambda.g, lambda.g being a wavelength of the microwave.

Chen et al teach a plasma apparatus with a gas injection opening 38, an evacuation opening 3a (normally connected to a vacuum pump) and further comprising a top plate unit with a flat plate portion and a side wall portion that extends towards a substrate. Chen et al further teach that window can also be made in two pieces like a flat plate portion 100c and a curved piece 100d, so that the sides of the flat portion and the sidewall portion facing a plasma generation region have a curved surface extending between the flat plate portion and the sidewall portion (e.g. Fig 6b). Chen et al also teach that geometry and material properties of the dielectric top plate are optimized (like result effective variables) to optimize the microwave distribution in the chamber, and also as per required microwaves modes. It would be obvious to replace the dielectric top plate unit of Watanabe et al with the dielectric top plate unit as taught by Chen et al and optimize its shape and material properties to further control and optimize the plasma distribution in the process chamber. Thus by selecting the thickness and dielectric material constant of the dielectric top plate 120 (for example in Fig. 14a), control of the microwave electric field amplitude in the chamber is enabled. Chen et al additionally teach that as an example (Fig. 3) for proper matching, the thickness of the dielectric top plate 9 is made equal to ¼ times lambda.g, multiplied by an integer (e.g. Figs. 3, 4, 8, 14a and col. 8, lines 50-68 and col. 12, lines 60-68 and col. 15, line 44 to col. 16, line 25). It would be obvious to control the shape of the dielectric top plate unit and optimize the thickness of the side wall portion of the top plate unit as per teaching of Chen et al in the apparatus of Watanabe et al to control plasma distribution in the process chamber.

Therefore it would have been obvious to one of ordinary skills in the art at the time of the invention to optimize the shape and thickness of the side wall portion of the top plate as

taught by Chen et al in the apparatus of Watanabe et al to obtain required plasma distribution in the process chamber.

In this connection courts have ruled:

It would have been obvious to one having ordinary skill in the art to have determined the optimum value of a cause effective variable through routine experimentation in the absence of a showing of criticality. *In re Woodruff*, 16 USPQ2d 1934, 1936 (Fed. Cir. 1990).

Regarding Claim 5: Chen et al teach gas injection opening 3g for supplying gas into chamber along the side wall portion (Fig. 3).

Regarding Claims 6, 10: Chen et al teach that an outer periphery of side wall portion 120b is covered with a conductor 124 (metal wall of the chamber) without any gap (Fig. 14a).

Regarding Claim 7: Chen et al teach that inner shape of the dielectric top plate unit 120 is bell-jar type (Fig. 14a).

Claim 9 is rejected under 35 U.S.C. 103(a) as being unpatentable over Watanabe et al (JP 11-260594) in view of Chen et al (US Patent No. 5,234,526) as applied to claims 1, 5-7, 10 and further in view of Lebar et al (US 2001/0025607).

Regarding Claim9: Watanabe et al in view of Chen et al teach all limitations of the claim except a gap provided between the sidewall portion and the conductor.

Lebar et al teach a plasma apparatus comprising a chamber 12, a conductor portion 19, and a dielectric window 29 having a sidewall portion 31 that has a gap with the conductor portion 19 (e.g. Fig. 5 and para. 0029).

Therefore it would have been obvious to one of ordinary skills in the art at the time of the invention to provide a gap between the sidewall portion and the conductor portion as taught by Lebar et al in the apparatus of Watanabe et al in view of Chen et al to provide for thermal expansion between the dielectric material of the window and the metallic conductor portion that have different thermal coefficients of expansion.

Claims 11, 15, 18 and 19 are rejected under 35 U.S.C. 103(a) as being unpatentable over Watanabe et al (JP 11-260594) in view of Chen et al (US Patent No. 5,234,526) and Ishii et al (US PGPUB No. 2002/0038692).

Regarding Claim 11: Watanabe et al in view of Chen et al teach all limitations of the claim (as already explained above under claim 1) including a dielectric top plate unit having a flat plate portion and a side wall portion, and wherein sides of the flat portion and the sidewall portion facing a plasma generation region have a curved surface extending between the flat plate portion and the sidewall portion, and a slot antenna in close contact with the dielectric top plate unit.

Watanabe et al in view of Chen et al do not teach a gap distance between the top plate unit and the antenna.

Ishii et al teach a plasma apparatus with a slot antenna that is disposed above a dielectric top plate with a gap there-between. Ishii et al further teach that by controlling the gap d2 between the antenna 30 and the dielectric plate 13, a radiation angle .theta. can be controlled. Ishii et al also teach that by controlling the radiation angle theta. the plasma generation due to the electromagnetic fields directly incident from the radial antenna 30 becomes dominant to permit accurate control of the plasma distribution (Fig. 1, 14, 15 and para. 0106, 0144-0147). It would

be obvious to optimize the gap between the antenna and the dielectric top plate (as a result effective variable) in the apparatus of Watanabe et al in view of Chen et al to permit accurate control of plasma distribution in the plasma chamber.

Therefore it would have been obvious to one of ordinary skills in the art at the time of the invention to optimize the gap between the antenna and the dielectric top plate in the apparatus of Watanabe et al in view of Chen et al as taught by Ishii et al to permit accurate control of plasma distribution in the plasma chamber.

In this connection courts have ruled:

It would have been obvious to one having ordinary skill in the art to have determined the optimum value of a cause effective variable through routine experimentation in the absence of a showing of criticality. *In re Woodruff*, 16 USPQ2d 1934, 1936 (Fed. Cir. 1990).

Regarding Claim 15: Chen et al teach that geometry and material properties of the dielectric top plate are optimized (like result effective variables) to optimize the microwave distribution in the chamber, and also as per required microwaves modes. Thus by selecting the thickness and dielectric material constant of the dielectric top plate 120 (for example in Fig. 14a), control of the microwave electric field distribution in the chamber is enabled. Chen et al additionally teach that as an example (Fig. 3) for proper matching the thickness of the dielectric top plate 9 is made equal to ¼ times lambda.g, multiplied by an integer (e.g. Figs. 3, 4, 8, 14a and col. 8, lines 50-68 and col. 12, lines 60-68 and col. 15, line 44 to col. 16, line 25).

Regarding Claim 18: Chen et al teach that inner shape of the dielectric top plate unit 120 is bell-jar type (Fig. 14a).

Regarding Claim 19: Chen et al teach gas injection opening 3g for supplying gas into chamber along the side wall portion (Fig. 3).

Conclusion

Any inquiry concerning this communication or earlier communications from the examiner should be directed to RAKESH K. DHINGRA whose telephone number is (571)272-5959. The examiner can normally be reached on 8:30 -6:00 (Monday - Friday).

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Parviz Hassanzadeh can be reached on (571)-272-1435. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

/Rakesh K Dhingra/
Examiner, Art Unit 1792

/Karla Moore/
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